A Datapro Feature Report

How to Select and Use Data Entry Devices

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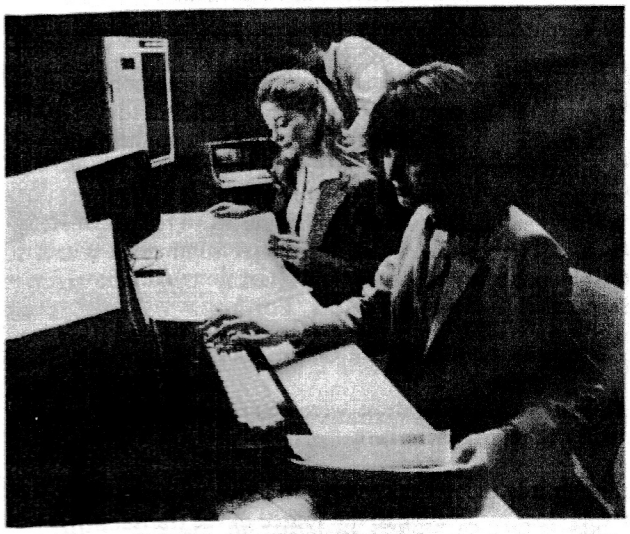
How to Select and Use Data Entry Devices

This report explores the full spectrum of general- and special-purpose data entry devices and lists factors for equipment selection. It also discusses the concept of distributed data entry and includes information on future market developments.

Industry observers believe this decade will see a gradual decline in the use of traditional data entry equipment accompanied by a growing demand for products designed for source data capture and distributed environments. Intelligent terminals, on-line CRTs, factory data collection systems, and key-to-disk equipment are expected to be the products most in demand. There is also a growing interest in mixed-media data entry systems and in user-friendly systems which could be used by relatively unskilled personnel.

The market for keypunches, key-to-tape, key-to-diskette, and key-to-disk devices will remain viable in the near future. There is a large installed base of keypunch devices and many end users still believe the devices are the most cost-effective method of data entry. The market for key-to-disk systems will experience some growth due to their replacement of keypunch systems and an increase in communications capabilities. Key-to-diskette systems, which have succeeded key-to-tape devices, are expected to decline at a faster rate than keypunches because their end-user applications are easily upgraded for use with intelligent terminals. Intelligent terminals are projected to capture the largest share of end users migrating from traditional types of data entry equipment, followed by on-line CRTs and optical character readers (OCR). Voice data entry is also expected to gain acceptance as technological advances lower the cost and increase recognition reliability.

The trend towards decentralized data entry is confirmed by the results of Datapro's 1981 survey of key entry equipment users (see Report 70D4-010-72). The percentage of keypunch, key-to-diskette, and key-to-disk devices has declined since 1978 while the number of on-line CRTs and distributed processing systems have risen in popularity. Users planning to switch to another type of key entry equipment showed a clear interest in on-line CRTs and distributed systems.



The Inforex 9000 Distributed Processing System is designed for source and volume data entry, file management, and local networking.

The following paragraphs present factors for equipment selection, describe the functions and applications of each class of data entry equipment, and present examples of where special-purpose devices can be used effectively.

FACTORS IN DATA ENTRY EQUIPMENT SELECTION

The three primary factors in the selection of data entry equipment are:

- Transaction volume;
- Point of origin; and
- Transaction type.

These are of equal importance and must be fully investigated before an intelligent equipment selection decision can be made.

Transaction volume and point of origin must be considered together because individual remote locations within a company may generate sufficiently large transaction volumes to justify specialized equipment or multiple data entry systems at a single remote location.

Transaction type is naturally dependent on the specific industry, such as retail sales, banking, etc. There are, however, common factors which are present in all data entry activities regardless of the industry. These are discussed in some detail in the paragraphs that follow. To an EDP manager in a specific industry, the discussion may have no value, while to a consultant or corporate staff planner who may be concerned with multiple installations, identification of transaction type may be extremely valuable.

Secondary factors in equipment selection are accuracy and administrative controls. Accuracy controls are equipment features designed to assure data accuracy, such as verify mode, check digit validation, range checks, N-key rollover, and field accumulators. Administrative controls refer to accounting controls, data security, and prevention of employee dishonesty or error. Such controls may preclude the use of certain types of equipment or may dictate certain types of equipment, such as magnetic stripe card readers and PIN (Personal Identification Number) pads for employee and customer identification to the system. ▷

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Tertiary factors in data entry equipment selection include media compatibility and media costs. We will briefly discuss each of these primary, secondary, and tertiary factors.

Transaction Volume and Point of Origin

Data entry transaction or document volume is probably the single most significant factor in properly selecting data entry equipment. For example, volume analysis can help you determine whether or not an optical character reader or distributed processing system can be justified. Distinguishing between temporary and permanent volume increases can help you determine whether it is more practical to add a second or third shift to the data entry activity or to add more equipment and operators to the prime shift.

The data entry volume that originates from remote locations can help you determine whether data entry can be economically decentralized, or whether data collection equipment is a viable alternative to centralized keying. And, if your company is very large, the volume at each decentralized data entry location will be the determining factor as to which equipment should be selected for each remote location. Thus, volume and point of origin must be considered together.

Types of Transactions

For the purposes of this discussion, let us ignore the punching of program cards or associated data entry, and limit our attention to the entry of data for computer applications. There are three basic types of application input or data entry transactions:

1. *File additions,* such as new customer accounts, new part numbers, new employees, new vendors, etc., where the input transaction consists of adding a record or account not already contained in the file.

2. *File changes,* such as changes of address, credit limit, marital status, beneficiary, number of dependents, job classification, gross pay, voluntary deductions, etc.

3. *File activity,* which consists of the day-to-day transactions for established files that typically comprise 90 percent or more of the total data entry job. These transactions include recording purchase orders, stock withdrawals, sales orders, shipments, invoices, and any other activity on any established file except for items 1 and 2 above.

Every file in an EDP data base has these three kinds of transactions associated with it. The significance of classifying input data into these groups is that, as a general rule, transaction Types 1 and 2 must be entered using general-purpose data entry equipment. General-purpose data entry equipment includes keypunches, key/disk systems, interactive CRT's, and any device which includes a full alphanumeric keyboard.

Type 3 (file activity) transactions can, of course, be keyed on the same devices as Types 1 and 2. However, file activity transactions usually are much simpler in nature; the data frequently consists only of numerics; and relatively few characters are required to record each transaction. Consequently, other, faster or less costly devices have evolved to record the transactions, to decentralize their recording, and to permit recording by untrained operators.

File activity transactions can be further classified as follows:

- *Turnaround transactions.* Billing is the most common type of turnaround transaction. Bills are produced by the EDP system and sent to the customer. When the customer remits his payment, data from the returned invoice and the customer's check is used to update the file. Production purchase requisitions are an example of internal turnaround documents.

- *Source recording.* Retail POS terminals, bank teller terminals, and shop recording equipment are major equipment classes which perform data entry as a by-product of recording the transactions at the point where they occur.

- *Special advanced preparation.* Large groups of items or documents are prepared in advance, using high-speed methods, in anticipation of later being entered rapidly into the system. Examples are UPC-coded food products and consumer goods, prepunched or preprinted merchandise tickets, MICR characters on checks, embossed or magnetic striped credit cards, or (within a company) any large tub-file operation.

- *Inquiry/response.* Not all inquiry/response involves data entry. Inquiring of the system as to the availability of a specific part, quantity of material, seat on a specific flight, etc., is not data entry. However, if the item is available, the individual orders it, and it is thereby deducted from the available inventory, that *is* data entry. (A transaction has been processed.)

The file activity data entry of most companies includes some turnaround (customer invoices, purchase requisitions), some source recording (receiving, shipping), and some special advanced preparation (tub files) transactions; but frequently the volume of each is not sufficient to warrant considering specialized equipment for it, so the data is recorded manually on documents at the point of transaction and later keyed from the documents at the central data entry center. This is likely to be fine if you have fewer than 10 data entry operators. For larger volumes, it will probably pay you to study and classify the input to different files in more detail.

Accuracy and Administrative Controls

Hardware accuracy controls were enumerated above, so we will not repeat them here.

Although it is theoretically very attractive to locate data entry as close as possible to the source of the transaction, Σ

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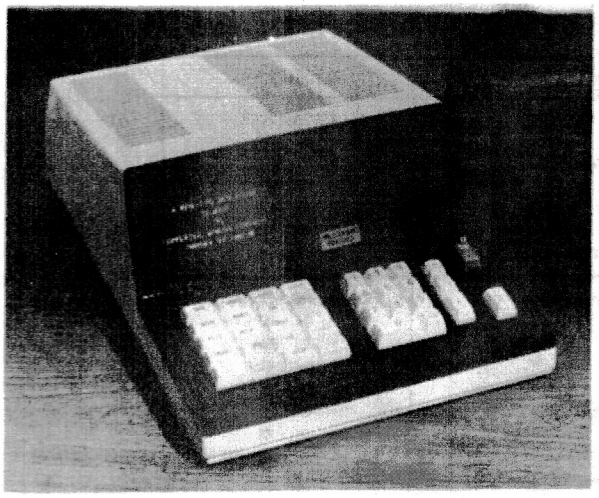

The Bunker Ramo bank teller terminal operates on-line in real-time to a host processor. Central files are updated as customer transactions take place, and all terminals in a branch network can access the latest data.

there are also potential dangers, depending upon the types of transactions to be entered. Today, with the emergence of distributed processing, it is necessary to decide, for example, whether it is desirable for the remote locations to be permitted to enter new accounts into the files. What controls, monitors, and audit trails does the system provide to thwart and discourage both potential dishonesty and innocent mistakes in the establishment of new accounts? The desirability of even permitting file changes, such as changes of beneficiary, from remote points is debatable because of the opportunities for conspiracy.

File activity transactions, on the other hand, are easier to control, and in most cases it is highly desirable to record them at the remote points where they occur. For example, the total of daily remittances received must equal the total posted to receivables, and this must equal the cash deposit to the company bank account at the location in question. Administrative controls such as these are fairly easy to impose on file activity transactions, so that the opportunities for dishonesty can be minimized.

The subject of security is much too large to treat in this report. However, being able to discuss data entry in terms of the type of transaction should facilitate the implementation of meaningful security measures.

Media Compatibility

The requirement for media compatibility in data entry is important only for:

- Data entry which is performed at a central location, or
- Media which are prepared at remote locations and physically transported to the host computer for conversion.

One cannot arbitrarily select a data entry device without due regard for the recording media it uses without running the risk of added expense and operational complications for a special conversion unit to transform the data into a form suitable for input to the computer.

Data prepared at remote locations which is transmitted (not transported) to the central site may be recorded on any convenient medium. Furthermore, largely because the mail is no longer rapid, reliable, or inexpensive, data transmission from remote locations is rapidly replacing the physical transporting of media. If a data transmission link is used, however, there are a host of communications factors that must be considered to ensure compatibility between the remote and central sites. These factors are described in Report 70G-050-01, *How to Analyze Your Data Communications Needs.*

Bear in mind also that it is possible to have data entry without physical recording media of any kind. Installations which use interactive CRT's for direct, on-line data entry do not require media. IBM's 3790 Data Entry Configuration, for example, is now available with magnetic tape output, but usually the controller is directly connected to the CPU. The magnetic tape output permits the user of a non-IBM system to use the 3790.

Media Costs

As a rule, reusable recording media such as magnetic tape, tape cassettes, and floppy disks are less costly than non-reusable media such as punched cards. However, fully as important as media costs themselves are media *storage* costs. The greater data capacities of magnetic recording media permit their storage in considerably less space than the equivalent capacity of punched cards.

Unless there is an operational requirement for punched cards (and even this should receive close scrutiny), magnetic recording media will generally prove more cost-effective.

DATA ENTRY DEVICES

Table 1 classifies data entry devices and systems by general type. At best, it will have a temporary usefulness because the names of the devices undoubtedly will change.

In the "General-Purpose" classification in Table 1, the devices/systems progress downward historically from the oldest (keypunch) to the latest (distributed processing systems). In the "Special-Purpose" classification, the entries progress from the most broadly applicable (data collection devices and systems) downward to the most specialized (speech recognition). We hasten to add, of course, that this general classification and ranking is our opinion and may be challenged by manufacturers who claim that their systems are truly general-purpose or have greater utility than some device which was ranked higher. Compare the capabilities of each type of equipment to your needs, and make your own decision.

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TABLE 1. CLASSIFICATION AND RANKING OF DATA ENTRY DEVICES/SYSTEMS

Classification	Method/System/Device	Ranking
General-Purpose Data Entry	Keypunch	Oldest
	Standalone keystation (cassette, diskette, or ½-inch tape)	●
	Shared-processor key/disk system	●
	Interactive remote terminal	●
	Intelligent terminal	●
	Distributed processing system	Most recent
Special-Purpose Data Entry	Industrial data collection system/device	Most generally applicable
	Optical character reader	●
	Optical mark reader	●
	Point of sale terminal	●
	Bank teller terminal	●
	Voice response/Touch-Tone telephone	●
	MICR encoder/reader	●
	Speech recognition device	Most specialized

The test of whether a device is general-purpose or special-purpose is this: Can a completely new account (including name and address or other alphabetic description) be entered into the EDP system using this device, and can the operator or supervisor verify that it was entered correctly? If you get a satisfactory answer to those questions, you have a general-purpose device. If you don't, you have a special-purpose device.

Table 2 shows the types of input transactions that can be handled effectively by each type of data entry device.

GENERAL-PURPOSE DEVICES AND SYSTEMS

The functional characteristics and comparative strengths and weaknesses of each type of general-purpose data entry equipment listed in Table 1 are described in the paragraphs that follow.

Card Punches and Verifiers

The durability of keypunches is partly explained by the fact that they are "old friends" to many computer professionals. Punched cards are comfortable. To the average person (computer professionals included), it is natural that data be contained in punched holes on a card—holes can be seen. On the other hand, many people feel that magnetic patterns in tape or disks or cores, or the electrical states of tiny solid-state electronic components, are intangible and therefore disquieting.

Modern-day keypunches are buffered and can be used for both punching and verifying. They are available in both interpreting models (which print along the top edge of the card while punching) and non-interpreting models. There are 80-column keypunches supplied by Decision Data, IBM, Sperry Univac and Tab Products Company. IBM also makes 96-column keypunches; but unless you already have an IBM System/3 computer that uses such cards, we do not recommend acquiring one, because the 96-column card, though newer, is much closer to extinction than the 80-column card.

The most advanced keypunches available are the Sperry Univac 1800 Series units, which are microprocessor-based keypunches offering data checking and validation capabilities usually found only on key/disk systems. Keying speed and card throughput are increased through buffering and overlapped verifying and card reading operations.

When is the keypunch a wise choice? The following characteristics would seem to favor keypunches: 1) need for a small number of data entry stations; 2) need for a relatively smaller number of program formats, say, no more than about 10; 3) ability to work effectively with 80-character records; 4) absence of a need for rapid and systematic searching of the recorded data records; and 5) absence of a need for immediate printouts.

Standalone Keystations

Standalone keystations include classic key/tape recorders, such as the Honeywell and Mohawk units, that record on 1/2-inch industry-compatible magnetic tape; key/cassette recorders, such as the early Sycor and Datapoint units; and the more recent key/diskette units, such as the IBM 3740, the Sperry Univac UDS 2000, and the Tab Products 700 and 800. A standalone keystation can be remotely located and equipped with a communications capability, and this is an important use today. As stated earlier in this report, media compatibility is not important for remote units if the data is transmitted to a central location.

Keystations which record on 1/2-inch tape are obsolete. Those installations which still use them almost invariably purchased them years ago. Datapro cannot recommend that such equipment be considered today. Even the keystations which record on Philips-type cassettes are being displaced by units which record on diskettes.

There is no clearly observable distinction between a standalone keystation and an intelligent or quasi-intelligent terminal; however, keystations such as the IBM 3740

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TABLE 2. APPLICATION OF DATA ENTRY DEVICES TO INPUT TRANSACTION TYPES

Device	Type of Input Transaction					
			File Activity Recording**			
	File Additions	File Changes	Turnaround	Source Recording	Special Advance Preparation	Inquiry/ Response
General-Purpose Systems/Devices—						
Keypunch	○	●	●	●	●	—
Standalone keystation	●	●	●	●	●	—
Key/disk system	●	●	●	●	●	—
Interactive remote terminal	●	●	●	●	●	●
Intelligent terminal	●	●	●	●	●	*
Distributed processing terminal	●	●	●	●	●	—
Special-Purpose Systems/Devices—						
Data collection system	—	—	—	●	—	*
Optical character reader	*	*	●	●	●	—
Optical mark reader	*	*	●	●	○	—
POS terminal	—	—	—	●	—	*
Bank teller terminal	*	*	—	●	—	●
Voice response device***	—	—	—	●	—	●
MICR encoder/reader	—	—	*	*	●	—
Speech recognition device	—	—	—	●	—	—

*Under highly specialized, tightly controlled conditions only.
**See text for discussion of each file activity type.
***In conjunction with Touch-Tone telephone

Sperry Univac 2000, and Tab Products 700 and 800 are designed for high-volume data entry and have some distinguishing features. For example:

- The CRT screen is relatively small so that it does not command the operator's attention. It is consulted for status indications, error messages, and similar extraordinary events or conditions. The attention of the operator is concentrated on the source documents being keyed.
- The keyboard is movable to the most comfortable angle for the operator without affecting the position of the CRT.
- The keystation includes a work surface adequate to store several batches of completed documents plus the batch being worked on and one or two "to be keyed" batches.
- The recording media can be inserted and removed by the operator from the normal seated position.

These stations have built-in features, such as verify mode, automatic skip/duplicate, right justify, left zero fill, check digit validation, batch balancing, and search, which are aimed at volume data entry.

Standalone key/diskette units should prove to be cost-effective where the volume cannot justify a shared-processor key/disk system and where there is no operational requirement for punched cards. For additional information, see Reports 70D4-491-41, 70D4-818-02, and 70D4-877-25, which describe the IBM 3740, the Tab Products 700 and 800, and the Sperry Univac 2000, respectively.

Shared-Processor Key/Disk

The most sophisticated form of keyboard data entry available today is the multiple-keystation installation in which a common minicomputer processor and disk storage facility are shared among the various keystations. Nearly always, the primary output of such a system is industry-compatible 7- or 9-track magnetic tape with recorded densities ranging from 200 to 1600 bits/inch. The tapes are written from data records stored on the common disk drive, which serves as an intermediate storage medium. Data records on the disk can also be transmitted directly to the central computer over a communications line, and the use of this form of output is increasing.

Multi-station key/disk systems accentuate operator productivity in a way that no other type of data entry system can. They essentially strip the keystation operator of all responsibilities except the single-minded task of keying data. Apart from occasional entry of format programs, the keystation operator simply enters the assigned job and batch numbers to invoke the appropriate formats from the format program library. Then the operator simply keys the data, stopping only in response to environmental distractions.

The program defines fields as alpha, numeric, must-enter, skip, duplicate, and right- and left-justified fields. Levels of program control can usually be divided into three categories. One is control over system operations and functions; these are managed by a body of executive programs. They include utilities that operate the various system components, such as the CRT displays, functioning of the keyboard, multiplexing of the keystations to the shared components, operation of the peripheral

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devices, etc. A second level of programming formats, edits, and performs tests on incoming data as it is being keyed. Many keying errors and discrepancies in the data are discovered at this time. Programs responsible for such functions are often said to be in the foreground partition. The third software control level performs operations upon data records already stored in the disk pack. End-of-batch balancing is an outstanding example of an editing check that can be applied at this time. Programs for the implementation of a data record search procedure, for reformatting of stored data records prior to writing them onto output magnetic tapes, and for the blocking of records and the creation of headers and trailers are other examples. Programs of this class are often said to be in the background partition.

In the Verify mode, the operator summons the records to be verified by keying their batch and job number identities. Usually, relatively little of this tedious kind of verification is required in key/disk facilities.

Comparison of final totals compiled at the end of a batch with previously determined totals, sometimes called reference values, is called batch balancing or zero balancing. If zero balance is achieved, it is usually assumed that no verification of the records is necessary. If totals are out of balance, the records need be searched and verified only until ensuing corrections produce a balanced condition.

Range checking and table lookups also eliminate much verification. Often it is safe to assume that if the contents of a field have been verified as lying between prescribed limits (ranges), the contents are reliable and need not be verified. Similarly, if field contents are shown to conform with a table of allowable values, further verification is again unnecessary. That is why, in the more advanced systems, the occasional critical field that must be verified is specially designated in the format program.

The supervisor directs and monitors the operation of the entire system. Through the supervisory keyboard, communication is maintained with all system components.

Operator statistics constitute a particularly useful printout that the supervisor can request. Virtually all of the current multi-station systems produce such statistics. These statistics typically consist of operator identification, batch and/or file identification, operator start and stop times, number of keyed records, number of source document errors that had been bypassed, number of operator keystrokes, and the operational mode of this activity.

The systems also include a high-level language such as COBOL for user-developed applications, word processing application programs, and file management capabilities which enable the system to store and retrieve large volumes of data.

Key/disk data entry is definitely not for everybody. If volume is modest and editing performed by the central computer is satisfactory, probably the EDP manager should select modern electronic buffered keypunch-verifiers or key/diskette stations, as discussed previously. But there is absolutely no doubt that when data entry is substantial in volume, when a variety of formats must be implemented, when test procedures can eliminate virtually all formal verification, and when a disciplined operator staff would be more productive, the manager should think in terms of shared processor. If some source documents are suitable for optical scanning, he should also think in terms of multi-media systems.

The list of key/disk system suppliers is too long to include here. Please consult the Index under "key/disk" for a complete list of DATAPRO 70 reports on individual systems.

Interactive Remote Terminals

The most prevalent device to serve as an interactive remote terminal in a data entry system is the alphanumeric display terminal. The data entered at the keyboard is simultaneously stored in the CRT's buffer memory and displayed on the face of the screen. This permits the operator to visually verify the correctness of the data before entering it into the central computer system. Depending on the way the system is programmed, large quantities of data can be displayed on the screen as a single record prior to data transmission.

The central computer can perform routine edit checking or more detailed accuracy checking. The operator can be notified at once of the error and solicited for re-entry of the data. Thus, the error correction cycle can be compressed to its logical minimum. There is no separate verify mode on this type of configuration. Data is system-verified and sight-verified, but not key-verified.

Multiple CRT devices can be scattered about in the same or different facilities, simultaneously entering related or non-related data to the same central computer system for temporary disk storage and eventual processing. Thus, the relatively high costs of the central computer facility can be shared by a number of different users, both at the remote locations and also at the central location, where the computer can be concurrently performing local batch processing. An extreme example of a large dispersed terminal system is an airline or car rental reservation system.

It is interesting to note that the "keystrokes per hour" figure for interactive remote terminals is considerably lower than other types of data entry devices according to Datapro's 1981 user survey; see Table 4 in Report 70D4-010-72, *User Ratings of Key Entry Equipment.*

Costs of interactive data entry will continue to drop over the next few years, and the usage of on-line data entry systems will rise significantly. Costs of the remote terminals themselves will decrease, but, more significantly, computer hardware and software improvements will make it operationally feasible and economically desirable to

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share the costs of the central computer among many concurrent users, both local and remote. Data communications networks will also decrease in cost while noticably increasing in reliability, all encouraging the increased use of such data systems.

For more information about today's interactive terminals, please refer to Report 70D2-010-15, *All About Alphanumeric Display Terminals.*

Intelligent Terminals

This type of device exists on two levels: the *quasi-intelligent or "smart"* terminal, which provides formatted data entry and editing capability; and the *user-programmable* terminal, which can be used as a stand-alone computer as well as a communications terminal.

User-programmable terminals feature software support. The vendor typically provides an operating system, an assembler- or compiler-driven programming language, subroutines, I/O utilities, one or more protocol emulators, and one or two application programs, such as data entry and text editing. By definition, all user-programmable terminals have a user-accessible random-access memory (RAM) or equivalent. Winchester disks are gradually displacing the floppy disks used in terminal workstations and more pictures are being incorporated into workstations.

As a general rule, keypunches, standalone keystations, and key/disk systems are more cost-effective than intelligent terminals for centralized high-volume data entry. The latter, however, give users with unusual applications a high degree of data handling flexibility within a single compact unit.

There is now a trend away from the single-station data entry terminal towards clusters of small interactive terminals. Intelligent terminals are being predominantly used in vertical markets and are geared towards user-specific applications. Demand has been strongest from the banking, wholesale, manufacturing, transportation, and medical industries.

Intelligent terminals will experience an annual growth rate greater than that for other types of terminals. The value of intelligent terminal shipments of 1981 has already gone up by 50 percent from last year's figures. The installed base is projected to almost triple by 1985. Sales of intelligent terminals are expected to double when the new videodisk technology becomes perfected.

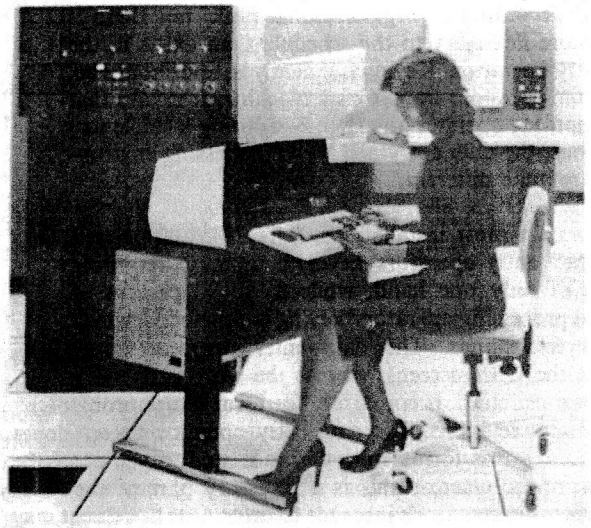
The leading suppliers of intelligent terminals are Raytheon Data Systems, Co., Four-Phase, Inc., Honeywell's Airline and Financial Industry Operation, and Datapoint Corp. IBM and Burroughs are expected to be among the top ten suppliers within the next five years. For more information on intelligent terminals, see Report 70D1-010-01, *All About User-Programmable Terminals.*

Distributed Processing

Historically, this concept was first developed in the early 1970's. The term "distributed data processing" was coined by key-to-disk manufacturers to describe remote multistation key-to-disk systems that had been enhanced to include local file storage and updating capabilities. Although programs are generally written at the central site and down-line loaded for local processing, high-level data entry languages have also been developed for use with these systems. In addition, minicomputer and terminal vendors have added to their product lines features that support the distributed processing concept. By providing remote sites with the capability to perform some data processing and file maintenance functions as well as data entry functions, a distributed processing system takes some of the load from the central CPU and lessens the local site's dependence on the central site's activity.

A distributed processing system may look exactly like a small key/disk system. The usual differences are as follows:

- There are usually fewer keystations.
- The keystations are typically desk-top CRT's, not integrated desks, keyboards, and displays. This is to reduce the amount of furniture rearrangement in the user department.
- CRT screens are larger, allowing for more operator interaction with the system and assuming part-time or inexperienced operators.
- Frequently there is no magnetic tape output from the system, but there is always disk storage and a communications interface. Data which is processed and stored on the disk may be transmitted to a central processor.



Beehive International's DM3270 alphanumeric display terminal emulates the IBM 3276-2 and can be used as a standalone unit or in clusters at remote sites.

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- Disk capacity is quite large relative to the number of keystations, allowing for file processing.

Distributed processing systems are best suited for operations with well-defined applications, batch communications, and centrally controlled program maintenance.

Distributed processing systems are offered by most of the key/disk system suppliers. Examples include the Inforex System 9000, the Mohawk Series 21, the Nixdorf 600 Series, and the Pertec XL 20/XL 40.

Enter Word Processing

It is now possible to obtain key/disk systems and distributed processing systems with word processing or text editing capabilities. There are, however, many differences between data entry and word processing in terms of objectives, environments, operators, and hardware/software. EDP managers and data entry supervisors should be aware of these differences, as discussed below.

Objectives: The objective of data entry is to get non-machine-processable information into machine-processable form as quickly, accurately, and inexpensively as possible. The end product is data for a computer to process and is not human-readable. The objective of word processing is to produce flawless printed documents. Printed documents are the end product. This is a vastly different objective than that of data entry.

Environments: Data entry normally is centralized, and jobs are carefully scheduled to coincide with certain computer runs. Data is always keyed from source documents. It is common to operate two or three data entry shifts per day. Many word processing centers also are centralized, but the scheduling is not determined by a computer. Usually it's on a first come, first served basis or according to organizational rank, but there is much more flexibility to the schedule than exists in the data entry operation. Keying frequently is, and should be, done from an audio transcribing machine. It is rare that the equipment operates any time but during a single day shift. Thus, the data entry and word processing environments are quite different.

Operators: In most installations, fully 75 to 80 percent of the data entry operators' keying is numeric, requiring the use of only one hand, while 85 to 90 percent of the word processing operators' keying is alphabetic, which requires two hands. The data entry operator rarely looks at the CRT screen, whereas the word processing operator must check it constantly for form setup, proofing, and text revisions. The data entry operator doesn't load and remove forms or letterheads and envelopes from a printer, whereas this is a necessary part of the word processor operator's job. One record may take a data entry operator a few seconds to enter. One document may take several minutes for a word processor to print out. Different operator temperaments and skills are called for.

Hardware/software: It is easy to isolate a word processing printer, with its requirement for typewriter-quality printing, as an additional peripheral for a key/disk system. However, the word processing software will require additional memory, including work areas, and the software may be priced separately. State-of-the-art CRT-based word processing terminals are capable of displaying a full 8½-by-11-inch typed page on the screen. This calls for a different type of CRT display than one normally associates with a key/disk or distributed processing system.

What we are really cautioning the reader against is a line of thinking in which the user assumes that he can get word processing "free" or for a few dollars more in monthly rental on a key/disk system. Such thinking is bound to result in disappointments.

Considering these differences in objectives, environment, operators, and hardware software, the most practical configuration of key/disk or distributed processing systems that include word processing is one in which the word processing hardware (terminals and printers) is physically located in a different room than the data entry terminals. The word processing terminals can communicate with the shared processor over cables, if the distance is not great, or over telephone lines. Such an arrangement automatically compensates for environmental and operator differences, and also permits convenient charging of the word processing hardware to administration or user departments. (Some additional charge should be made for additional memory, system time, and any unbundled word processing software.)

This type of shared-processor data entry/word processing configuration is an early manifestation of the "automated office." There is no doubt that this is the direction in which we are headed. However, as discussed above, hardware and software are not the only considerations in implementing advanced concepts.

SPECIAL-PURPOSE DEVICES AND SYSTEMS

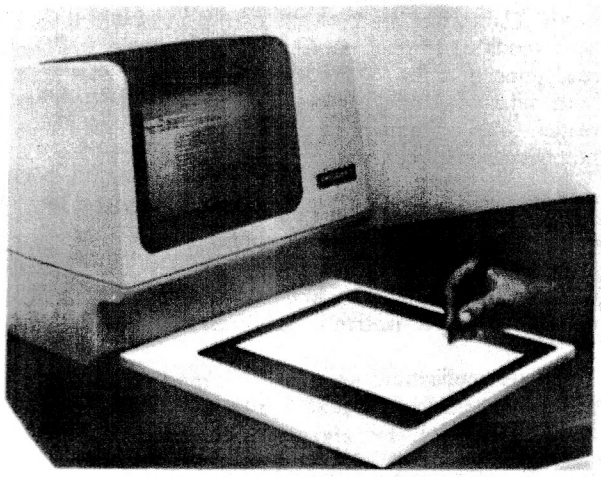
The functional characteristics and applications of the various types of special-purpose data entry devices and systems, which are normally used only for recording file activity, are discussed in the paragraphs that follow.

Industrial Data Collection Devices

Industrial data collection equipment represents an example of source data collection, or source data automation, as it is often called. Source data automation is simply the conversion of information about an event or transaction into machine-readable form at the time when the event or transaction takes place and at the site where it occurs.

Industrial data collection equipment is used to monitor employee attendance, gather production control informa-

How to Select and Use Data Entry Devices



The Pencept System is a computer-based handprint recognition system available in both standalone and multi-unit configurations of up to 12 workstations.

tion, record labor distribution, collect inventory control data, and serve other related applications in an industrial environment. These systems usually consist of the following three classes of components:

- Input terminals that extract, format, and transmit both fixed data from prepunched cards, badges, or other previously prepared media and variable data from switches, dials, or keys.
- Cables, multiplexers, and/or communications equipment for transmitting data from the input terminals to an output unit located either within the plant or at a remote location.
- Output units that organize the data received from the remotely located input devices and record this data onto punched cards, punched tape, or magnetic tape for entry into a computer. (Some output units control the direct entry of formatted data into a computer system.)

There are also completely portable devices which are battery-operated and record data on a cassette or in semiconductor memory. A number of portable data collection devices feature alphanumeric capabilities, and some new programmable models allow users to create their own special software packages.

Source data collection has two important advantages over alternative methods of input preparation. First, it reduces the number of times that data must be transcribed and the number of locations at which such procedures must take place. Hence, errors are avoided and many clerical costs are either reduced or eliminated. A more important advantage is the nearly instant availability of data. Data that describes the status of a plant, warehouse, or store can be kept current, and operating decisions can be based on actual conditions rather than on superseded statistics. Modified versions of these systems are also used in hospitals and schools.

Industrial data collection devices are specifically designed to facilitate accurate data entry in a hostile environment. They are comparatively low in cost, highly durable, and easily operated by non-skilled personnel. One industry report predicts that sales of hand-held data entry devices will grow by 19 percent annually through 1984. There will undoubtedly by more progress in developing integrated data collection systems, rather than standalone devices. On-line systems will continue to increase.

For more information about this class of equipment, please refer to Report 70D4-010-85, *All About Data Collection Equipment.*

OCR Devices

Optical Character Recognition (OCR) devices read typewritten, computer-printed, and in some cases hand-printed characters from ordinary documents. The machines range from high-speed (up to 2000 documents per minute), automatically fed machines costing hundreds of thousands of dollars down to a hand-held wand attached to a POS terminal which reads only numerics in a single type font.

The most widespread application for OCR machines is the reading of turn-around documents prepared by computer line printers. If you examine your electric or gas bill carefully, you will probably see that it is printed in a stylized font. Look also at your insurance premium notice and your bills from department stores. All of these organizations are heavy users of OCR.

If your EDP installation processes any single document with a volume of 5000 or more documents per day, we suggest that you read Report 70D4-010-78, *All About Optical Readers*, very carefully, as you are a probable candidate for OCR.

We should make the point that there are no practical OCR devices that read *handwriting*. There are machines that read hand *printing*, which means that the characters must be printed in individual boxes of carefully controlled design and size. At present only Scan-Data Corporation produces equipment that will read hand-printed *alphanumerics*. Other optical readers read only hand-printed numerics and a few symbols.

There are OCR machines which read combinations of machine-printed numerics, machine-printed alphanumerics, hand printing, and marks from the same document.

A number of key/disk suppliers will provide an OCR unit as a peripheral for their systems. The resulting configurations are referred to as *mixed-media or multi-media systems.* Examples of mixed-media systems that combine OCR and keyed data entry include the Consolidated Computer Key-Edit Series 2, the Cummins-Allison KeyScan System, the Recognition Equipment Total Data Entry System, the Scan-Data 2250, and the Scan-Optics Scan-Edit Systems.

How to Select and Use Data Entry Devices

Another recently developed class of equipment that utilizes OCR is the *payment processing or remittance processing systems*. These are special systems designed to automate the processing of remittances—or, as in the case of the IBM 3762 unit, a special terminal which is part of a general-purpose key/disk system. Each terminal or station contains an optical character reader which reads the account number and (usually) the amount from the returned bill stub. If the customer pays an amount which is different from the billed amount, the operator keys the amount. The terminal also usually can print a journal tape, apply a control number to the document for auditing purposes, and, in some cases, MICR-encode the amount on the customer's check.

This equipment is conceptionally different from the traditional centralized high-speed OCR installation, even though both types of equipment read or process the same types of documents. The payment processing systems were developed primarily for lock box operations in commercial banks, and features such as endorsement printing and MICR encoding make them highly bank-oriented. Primitive versions of this type of equipment appeared in 1969 (Allied Computer's Readoc), but were unsuccessful commercially. At present, we regard the payment processing systems as specialized subsets of the key/disk systems. For additional detail on this type of equipment, see Report 70D4-491-43 (*IBM 3790 Data Entry Configuration*), and *DATAPRO REPORTS ON BANKING AUTOMATION*. Current manufacturers of payment processing systems include Ball Computer Products, Bell and Howell, General Instrument Corporation, and IBM.

Also on the market is a system from Pencept Inc. which converts handprinted alphanumeric characters directly into computer input codes as each character is printed. Each operator station consists of a coordinate sensing tablet on which is placed the preformatted form to be filled in, plus a small display that permits the operator to sight-verify that the characters just printed were correctly recognized. Errors can be corrected by overprinting the right information. Pencept claims that its system accepts a wide range of handprint styles.

OCR will be increasingly attractive to many users because it is not labor-intensive, it provides greater reliability by eliminating input errors, and it can be used in conjunction with word processors and typesetters. Prices are expected to drop as low as $7,000 for high-capability OCR equipment for office applications.

Mark Readers

These devices optically read carefully controlled pencil marks on especially designed and carefully printed documents. Thus, they can enter data directly into a computer system without any form of intermediate data transcription.

There are two types of mark readers: machines which handle 80-column cards and machines which handle pages. The former are basically card readers which have been modified to read marks and may or may not also read punched holes. Some mark readers can read from both sides of a card or page in one pass through the reader. The computer must correlate the marks with preprogrammed data to determine their significance.

The mark sensing technique has long been popular in the educational community in such applications as scoring test papers. In this case, the mark is entirely adequate in determining yes, no, true, and false selections, as well as others in which a relatively few choices are possible.

There are applications which utilize a mark reader to scan turnaround documents prepared by a high-speed printer. A description of this and other applications of mark readers is contained under the discussion of Mark Readers in Report 70D4-010-78, *All About Optical Readers*.

Point of Sale Devices (POS)

A point of sale device is the electronic equivalent of a cash register, but is generally capable of capturing more information than a conventional cash register can. There are standalone POS terminals which record data on an integral cassette, but the majority are wired to a minicomputer controller which records the data from all the terminals in a store. Each store functions independently. The store controller communicates over telephone lines with the central site and the host EDP system for all stores.

Three distinct types of POS terminals and systems have evolved for use in three distinct retail segments: general-merchandise terminals capable of printing either a simple receipt or an elaborate sales check; supermarket terminals with provisions for identifying food stamps and vendor coupons as part of the transaction payment; and "fast food" terminals in which a single key depression can record a sale and deduct an inventory item.

The significant features of most of the current electronic POS devices for retail use include:

- Capability for entering extensive information such as product code, credit card number, etc. Some of this information can in many cases be entered without keying, through the use of auxiliary equipment such as OCR wands.
- Ease of use, with the operator being led through the many types of possible transactions by a series of lighted indicators or messages.
- Provision for transmission of data to a central computer for credit checking and/or collection of product flow statistics.
- Provision for local computational capability for price extensions, tax calculations, etc.

The devices for supermarkets generally have more specialized keyboards for quick product group entry, and many

incorporate optical scanning devices for automatically capturing the manufacturer and product codes from the food package itself, using the standard UPC bar code. Once this information is captured, a store controller (minicomputer) can furnish the prices. The object of the supermarket and "fast food" POS equipment is to speed the physical checkout function as well as to capture product information.

Detailed information about POS equipment and techniques can be found in a companion publication, *DATAPRO REPORTS ON RETAIL AUTOMATION.*

On-line Bank Teller Terminals

What the POS terminal is for the retail store, the on-line teller terminal is for the bank. In most cases, all of the terminals in a bank branch are controlled by a minicomputer in the branch, which communicates over telephone lines with the bank's central EDP system. However, whereas the store system may communicate only occasionally with a central file, the bank system normally will interrogate the central EDP file to check the account balance for each withdrawal, check cashing, or customer inquiry transaction.

An individual teller position normally will include a keyboard and display and some sort of receipt printer. A passbook printer for savings accounts may be shared by two or more tellers. The terminals may have magnetic stripe card reading capability, and the teller position may also have a PIN (Personal Identification Number) pad for the customer to enter his "secret" PIN, thus identifying himself to the system and preventing use of his card by an unauthorized person.

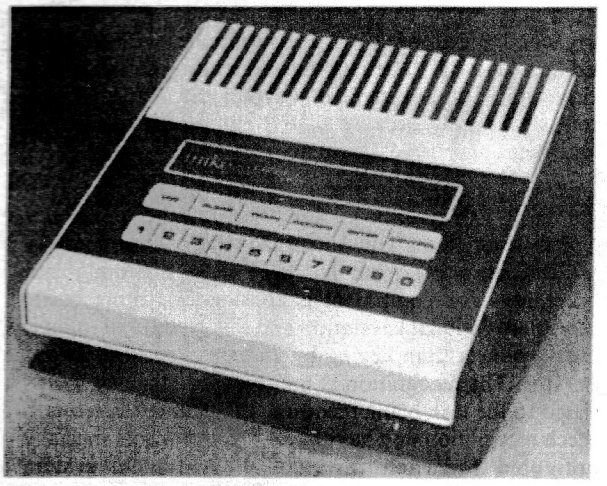
In addition to teller terminals, there are administrative (CRT) terminals for platform personal which may permit opening new accounts, obtaining credit reports, and reviewing account histories. Like POS, on-line banking terminals represent a large and specialized subject, and we refer the reader to *DATAPRO REPORTS ON BANKING AUTOMATION* for complete coverage.

Voice Response Systems

Strictly speaking, voice response is a computer *output* technique rather than a data entry technique. It may be employed, however, in specialized situations to *instruct* a person completely unfamiliar with data entry or EDP in how to enter data using a Touch-Tone telephone. In such an environment, voice response functions as the interactive element in data entry, and therefore as a logical adjunct to it.

Voice response can be considered when low-speed man/machine interaction is called for. So far, the banking industry has been the foremost proponent of this technique. Bank account status inquiries over tellers' phones and credit authorization for over-floor-limit credit card transactions constitute the principal applications.

Another fascinating application of voice response is made by the telephone company. When an operator intercepts calls for inoperative, disconnected, or changed telephone numbers, the operator simply keys the dialed number into a voice response system, and it proceeds to verbalize the proper reply to the caller.



Centigram's MIKE™ voice recognition unit can store up to twelve 16-word sets and offers an optional voice response feature.

This synthesis of human speech is a truly remarkable process. Essentially, the computer processes the received data, generates the necessary output data, and then organizes the output into an ordered set of addresses. Each address may correspond to a particular pre-recorded voice segment stored in the voice response unit; from the sequence of addresses, a sequence of voice segments is accessed, and the resultant sound composite is transmitted to the user as a spoken response. Other units use digital synthesis of generated frequencies and amplitudes to reproduce "human" voice.

Some of the companies in the voice response field are Burroughs, Cognitronics, Datatrol, IBM, Periphonics, and Wavetek Data Communications. Detailed information on voice response equipment can be found in Report 70G-420-01, *All About Voice Response.*

MICR Encoders and Readers

Magnetic Ink Character Recognition (MICR) readers, and the entire MICR technology of encoding documents with magnetically charged information for recognition by an MICR reader, is used almost exclusively by commercial banks for the processing of checks, deposit tickets, and similar documents related to demand deposit accounting.

Therefore, if your organization is a commercial bank, you must use MICR. If your company is not a commercial bank, there's probably no good reason to consider MICR as a data entry technique. It is a strictly numeric, highly inflexible technique designed around the unique requirement that *any U.S. bank* must be able to automatically process *any other U.S. bank's* checks. MICR has proven to be an effective solution to that requirement, but nothing more.

Any commercial bank with a computer will have, in addition to its MICR encoding and reading equipment, a fairly typical complement of keypunches, key/disk systems, etc., simply because MICR equipment is unsuited for general-purpose data entry.

Speech Recognition

Speech recognition equipment has been commercially available since 1972, but has been slow in gaining user acceptance. The equipment is considerably more costly than a conventional keystation and this method of input is actually slower than keying by an experienced keyboard operator. The recognition is limited to specialized words related to the task being recorded, plus numerics. Thus, a speech recognition unit has its repertoire of words specially configured for each installation. A typical system recognizes fewer than 50 words, although some systems can recognize a few hundred words.

Speaker-dependent systems have to be trained to recognize the speech of each operator. Each word or number must be individually spoken (e.g., 10,154 is spoken as one, zero, one, five, four) with distinct pauses between each word. The operator wears a headset-type microphone into which the words are spoken. Normally, this is wired to the recognition unit, although wireless microphones can be employed where operator mobility is essential.

Some newer systems have the capability to accept different pronunciations and continuous speech without inter-word pauses but these systems are also limited to small vocabularies.

Voice data entry may be appropriate for environments with some of the following characteristics: a computer-based reporting system, data entry protocol which can be structured, a limited or well-defined user population, operators who require mobility and hand and eye freedom, the ability to use a reasonable sized vocabulary, the need for source data capture, and phone access to computers.

Although speech recognition does not presently compete with other types of data entry equipment, it is expected to grow into a $1 billion industry by 1990 as costs come down and capabilities increase. Growing consumer acceptance of speech synthesis equipment and technological advancements in the semiconductor chip industry will focus attention on voice recognition as well. Some industry analysts foresee the day when computers will be programmed by voiced statements and speech will be directly converted into written copy.

Speech recognition has been employed in airline baggage sorting, certain types of material inspection, and preparation of numerical control tapes. Companies currently marketing speech recognition equipment include Centigram, Heuristics, Interstate Electronics, and Threshold Technology.

CLOSING ADVICE

In summary, the prospective user of a new data entry system should carefully study the data entry needs and characteristics of his present and proposed applications in light of the variety of input media and the myriad of data entry devices and techniques available to him. It is entirely possible that he will choose different devices and systems for different classes of applications.

Before making the final selection decision, the user might consider the following tips:

1. Choosing two or more different types of systems imposes added training requirements and reduces available back-up equipment in time of system malfunctions. These problems can be alleviated to some extent if the different systems are physically situated in different locations within the company.

2. The suppliers of the entry equipment should commit themselves to a certain minimum amount of operator training. Similarly, with more complex systems, they should guarantee a certain minimum amount of systems design and installation assistance.

3. The suppliers of this equipment should also guarantee a minimum level of hardware maintenance, including a statement of the maximum amount of time between service call and arrival of service personnel. Availability of replacement parts should also be clearly established.

4. Firm delivery schedules should be demanded as part of the contract. Such a demand will help sort out the serious and stable suppliers from the entrepreneurs with paper tigers.

5. On a similar note, the user should ask for a list of users of the selected equipment. They should be questioned about the reliability of the equipment, its ease of installation and daily use, and the amount of technical and systems support provided by the supplier. You'll also find a wealth of distilled user experience in Report 70D4-010-72, *User Ratings of Key Entry Equipment*, and in many of the other DATAPRO 70 reports.

6. Total systems costs should be carefully evaluated—not just hardware device costs. System costs above and beyond the hardware include personnel (operators and clerical support), training, media handling and storage, data conversions, back-up procedures, computer pre-processing time, and software programming. Each proposed device or system should be evaluated relative to the estimated costs of these elements.

7. In these days of unbundled prices, the prospective user should obtain a clear statement of exactly what is and is not furnished in return for his purchase or monthly lease payment.

The background information and selection guidelines contained in this report cannot guarantee a successful new data entry system, but they can guarantee a more informed rational buying decision. The selected system will be *capable* of fulfilling the desired data entry requirements, but it will remain for the users, as always, to make the system work.□